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54 Media type Identification system and method.

57 A diskette comprising a jacket, a liner material disposed within said jacket, a flat circular media having a magnetic coating on both sides disposed within said liner material, a hub attached at the center of said media, a plurality of optical positioning tracks on at least one of said sides of said media, and a media type code optically embossed on at least one of said sides of said media. The media type code contains information about the physical properties of the particular diskette that will allow a disk drive unit to auto-configure itself to allow optimum data communication and performance.

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BACKGROUND OF THE INVENTION1. Field of the Invention

- 5 The invention relates generally to magnetic disk drives and more specifically to high density removable media used in computer systems.

2. Description of the Prior Art

- 10 Continual advances in floppy disk technology have allowed the rapid migration from eight inch, to 5.25 inch to 3.5 inch diskettes. Originally, 5.25 inch diskettes held only 360K bytes of data, but higher track and more efficient recording formats have allowed the smaller 3.5 inch diskette to store as much as 1.44M bytes in the recent high density (HD) format. Such rapid migration has caused severe interoperability concerns, because of the physical incompatibility between the traditional formats. The recent HD format is a ray of
15 hope that the situation will improve, in that both Apple Macintosh IIs and IBM-PCs equipped with HD drives record in basically an interchangeable format.

- Advances in floppy disk technology have not stayed still. By embedding optical servo information in an otherwise standard 3.5 inch micro-floppy diskette, storage capacities of twenty megabytes and beyond are possible. The Micro Standards Committee, sponsored by the Microcomputer Managers Association, announced at COMDEX/Spring 1989 a 10-month study of proposed new formats to replace the aging 1.44M
20 byte diskette. (See, "Draft White Paper on a New Standard for Very-High-Density Diskette Drives," February 5, 1990, published by the Micro Standards Committee, 50 W.34th St., Suite 23C7, New York, NY 10001.) The result was to recommend a 20.9M byte optical-magnetic format that was judged to be superior on every criterion rated.

- 25 In the prior art, only two devices have been used on diskettes to signal to a drive special properties of the diskette. Both have been mechanical. The original eight inch floppy disks had a notch in the jacket that was covered to prohibit writing on the disk. Some diskettes have a mechanical switch that allows/prohibits writing. The latest HD micro-floppy diskettes have a hole to differentiate them to the disk drive from earlier 400K byte (Apple), 722K byte (IBM), or 800K byte (Apple) 3.5 inch diskettes. The 2.88M byte industry
30 format has a capacity hole in yet a different location than the 1.44M byte diskette. To guard against improper formatting a drive should have three switches, one for write protect and two to detect capacity. Other than that, the prior art has not placed any information on the recording surface of a diskette to allow the disk drive to auto-configure itself to the particular diskette inserted.

35 SUMMARY OF THE PRESENT INVENTION

It is therefore an object of the present invention to provide a media type code to identify the various physical properties of a particular removable diskette.

- Briefly, an embodiment of the present invention is a diskette comprising a jacket, a liner material
40 disposed within said jacket, a flat circular media having a magnetic coating on both sides disposed within said liner material, a hub attached at the center of said media, a plurality of optical positioning tracks on at least one of said sides of said media, and a media type code embossed on at least one of said sides of said media and detectable by a magnetic read/write head.

- An advantage of the present invention is that a disk drive can automatically configure itself to the
45 particular type of diskette inserted out of a possible field of a plurality of possible types.

Another advantage of the present invention is that special coating formulations on a diskette can be indicated to a disk drive.

Another advantage of the present invention is that a twenty megabyte diskette can be constructed that is compatible with prior art 720K and 1.44M byte 3.5 inch diskettes.

- 50 Another advantage of the present invention is that individual data tracks of a diskette can be write protected.

These and many other objects and advantages of the present invention will no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiments which are illustrated in the various drawing figures.

IN THE DRAWINGS

Fig. 1(a) is an elevational view of a diskette showing the flat circular media inside with dotted lines. Fig. 1(b) is an elevational view of the flat circular media with the jacket and liner removed from the diskette of Fig. 1(a);

Fig. 2 is a disk drive having the diskette of Fig. 1(a) inserted into it;

Fig. 3 is another elevational view of the flat circular media within the diskette of Fig. 1(a) showing details of the concentric data tracks, the reference cylinder, and the media type code track; and

Fig. 4 is a diagram of the 37-bit media type code recorded on the media type code track of the diskette media shown in Figs. 1-3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1(a) is a diskette, referred to by the general reference numeral 10, comprising a jacket 12, a label 14, a shutter 16, and a media 18. A liner is disposed within jacket 12 and is made of a material that lubricates and cleans media 18. (The liner is conventional, and is not described further here.) Fig. 1(b) shows that media 18 is connected at its center to a hub 20. A write-protect notch 22 and a diskette density notch 24 provide basic information about diskette 10 to a disk drive (described below). Media 18 is flat and circular and has magnetic coatings on its two surfaces. Preferably, media 18 is coated with barium ferrite. (Coatings of ferric oxide will work, but not as well as barium ferrite.)

Fig. 2 is a disk drive system, referred to by the general reference numeral 30, comprising an optical-magnetic disk drive 32 and diskette 10. Disk drive 32 positions its heads according to optical servo information and reads and writes data magnetically. If disk drive 32 senses that a slider (not shown) within write protect notch 22 is in a first position, then disk drive 32 will not attempt to write any data on diskette 10. If disk drive 32 senses that the slider in write protect notch 22 is in a second position, then disk drive 32 will be enabled to write data on diskette 10. The presence of diskette density notch 24 indicates to disk drive 32 that diskette 10 is a "high density" disk. The absence of diskette density notch 24 indicates to disk drive 32 that diskette 10 is not a "high density" disk. Media 18 is preferably spun within diskette 10 by disk drive 32 at 720 revolutions per minute (RPM). Preferably, disk drive 32 is downwardly compatible with conventional 720K byte and 1.4M byte 3.5 inch micro-floppy diskettes. Such downward compatibility would allow a computer attached to disk drive 32 to use new 20.9M byte very high density (VHD) diskettes, 1.44M byte HD diskettes, and 720K byte diskettes.

Fig. 3 shows that media 18 is comprised of a plurality of concentric (magnetic) data and (optical) servo tracks 34, a reference cylinder 35, and a track 36. Track 36 comprises a media type code (MTC) 38 that is a permanent feature of media 18, not subject to erasure. Preferably, track 36 is overwritten with a MTC magnetic track that repeats magnetically the same information as MTC 38 which is indelibly embossed in track 36. The MTC magnetic track is located at the point a magnetic read/write head detects as the centerline of the embossing of track 36. Track 36 is located outside the portion of media 18 reserved for the concentric data tracks and servo tracks 34 and reference cylinder 35. Track 36 can be placed elsewhere on media 18, but the position described here is preferred. Track 36 is substantially at the innermost limit of travel of a set of heads (having magnetic and optical pickups, not shown) within disk drive 32. Preferably, reference cylinder 35 has its centerline at a radius $866,140 \pm 50$ microinches from the center of hub 20 (and media 18). Reference cylinder 35 is preferably $1,440 \pm 20$ microinches wide. Track 36 is placed closer to the center of media 18 than cylinder 35, and has its centerline at a radius $863,731 \pm 50$ microinches from the center of hub 20 (and media 18). Track 36 is preferably 720 ± 20 microinches wide. The centerline of track 36 is preferably $2,409 \pm 50$ microinches from the centerline of reference cylinder 35. When diskette 10 is initially inserted into disk drive 32, track 36 will be accessed and media type code 38 will be read and used to configure disk drive 32 to a proper operating mode. Reference cylinder 35 and track 36 are preferably indelibly recorded, magnetically detectable tracks. "Zero" bits (false/low) are configured such that the leading portion of the bit consists of 200 microseconds of an unembossed disk surface of $13,025 \pm 17$ microinches followed by 400 microseconds of an embossed disk surface of $26,049 \pm 34$ microinches. "One" bits (true/high) are configured such that the leading portion of the bit consists of 400 microseconds of an unembossed disk surface of $26,049 \pm 34$ microinches followed by 200 microseconds of embossed disk surface of $13,025 \pm 17$ microinches. Media 18 is preferably embossed by laser etching or mechanical embossing using a hydraulic press. Although only one track 36 is discussed above, more may be added to accommodate any additional information contained in a large and expanded media type code 38.

Fig. 4 shows that media track code 38 preferably has three fields: a sync field 40, a data field 42, and a cyclic redundancy check field 44. Data field 42 comprises a 32-bit cell algorithm used to identify specific magnetic, optical, and servo properties of diskette 10 to disk drive 32. (Disk drive 32 will then use these to adjust itself to diskette 10.) Specifically, data field 42 comprises a reserved bits field for carrying data not otherwise defined, a servo code bit field to designate a particular servo system type, a security code bit field to designate particular read/write properties of said media, a magnetic data code bit field to designate the particular magnetic properties of said media, a media type code bit field to identify said media as being of a particular style, a capacity code bit field to designate the storage capacity of said media, and a machine compatibility code bit field. Table I summarizes the preferred number of bits and position of bits in the preferred configuration of media type code 38. Alternatively, media type code comprises a unique diskette serial number that is loaded into the disk drive 32 and available to a computer connected to disk drive 32. The serial number is useful as a key to unlock copy-protected software or to prohibit unauthorized use of computer systems.

TABLE I

FIELD	BIT #
synchronization	0
reserved	1-8
servo code	9-14
security code	15-16
magnetic data code	17
diskette type code	18-20
capacity code	21-24
machine compatibility	25-32
cyclic redundancy check	33-37

Diskette 10 has a permanent hole located so that a conventional 720K, 1.44M, or 2.88M drive will regard the diskette as being write protected. This protects from accidental erasure if an operator inserts diskette 10 (formatted for 20M bytes) into a conventional drive. (Diskette 10 will be unreadable by a conventional drive and a user is normally queried by a system whether or not the diskette should be formatted; The system will then attempt to format diskette 10 and this will be prevented by the permanent hole.)

Although the present invention has been described in terms of the presently preferred embodiments, it is to be understood that the disclosure is not to be interpreted as limiting. Various alterations and modifications will no doubt become apparent to those skilled in the art after having read the above disclosure. Accordingly, it is intended that the appended claims be interpreted as covering all alterations and modifications as fall within the true spirit and scope of the invention.

Claims

1. A disk drive memory system, comprising:

a removable media having a jacket, a liner material disposed within said jacket, a flat circular media having a magnetic coating on both sides disposed within said liner material, a hub attached at the center of said media, a plurality of optical positioning tracks on at least one of said sides of said media, and a media type code on at least one of said sides of said media; and

a disk drive means having means for accepting and ejecting the removable media, means for reading said media type code, and disk drive configuring means responsive to said media type code such that communication between the disk drive and removable media is optimized.

2. The system of claim 1, wherein:

the disk drive is downwardly compatible with conventional 720K byte and 1.4M byte 3.5 inch micro-floppy diskettes.

3. A disk drive compatible with a removable media, the removable media having a jacket, a liner material disposed within said jacket, a flat circular media having a magnetic coating on both sides disposed within said liner material, a hub attached at the center of said media, a plurality of optical positioning tracks on at least one of said sides of said media, and a media type code recorded on at least one of said sides of said media, comprising:

means for accepting and ejecting said removable media;

means for reading said media type code from said removable media; and

operating mode means responsive to said media type code such that data communication between the disk drive and a plurality of data tracks on said media is optimized.

4. The disk drive of claim 3, wherein:

said media type code is indelibly embedded and located outside an area reserved on said media for a plurality of concentric data tracks.

5. A removable media, comprising:

a jacket having a liner material disposed within the jacket;

a flat circular media having two surfaces and a magnetic coating on both of said surfaces, the media disposed within the liner material;

a hub attached at the center of the media; and

a plurality of optical positioning tracks on at least one of said surfaces of the media; and

a media type code on at least one of said surfaces of the media comprising data relating to the physical properties of the removable media important to the proper operation of a disk drive in communication with the removable media.

6. A media type code recorded on an embossed optical-magnetic media having a first surface area reserved for a plurality of concentric data and servo tracks, said media type code recorded in a second surface area, comprising:

a synchronization field;

a data field having a plurality of bit information identifying a plurality of operating characteristics of said media such that a disk drive can adapt itself to a proper interfacing mode to communicate with said media;

a cyclic redundancy code bit field comprising check bits resulting from using a polynomial derived from bits within the data field.

7. The media type code of claim 6, wherein the data field comprises:

a reserved bits field for carrying data not otherwise defined;

a servo code bit field to designate a particular servo system type;

a security code bit field to designate particular read/write properties of said media;

a magnetic data code bit field to designate the particular magnetic properties of said media;

a media type code bit field to identify said media as being of a particular style;

a capacity code bit field to designate the storage capacity of said media; and

a machine compatibility code bit field.

8. The media type code of claim 6, wherein the data field further comprises:

a media serial number bit field.

9. The media type code of claim 6, wherein:

said media type code is indelibly recorded on said media by a mechanical process by which groove-like features are placed on said second surface area.

10. The media type code of claim 6, wherein:

the synchronization field comprises one bit of data;

the data field comprises 32 bits of data; and

the cyclic redundancy code bit field comprises four bits of data.

11. A 3.5 inch micro-floppy diskette for storing in excess of twenty megabytes of data having a jacket, a liner, and a flat circular optical-magnetic media having a center point of reference and two surfaces, said media comprising:

a plurality of concentric data tracks and servo tracks on a first portion of at least one surface of said media;

a reference cylinder embossed on a second portion of at least one of said surfaces and along a centerline radius $866,140 \pm 50$ microinches from said center point of reference and being $1,440 \pm 20$ microinches wide;

a media type code track embossed on a third portion of at least one of said surfaces and along a centerline radius $863,731 \pm 50$ microinches from said center point of reference and being 720 ± 20 microinches wide, said centerline of the media type code track being $2,409 \pm 50$ microinches from said centerline of the reference cylinder, the media type code track comprising a media type code having "zero" bits configured such that the leading portion of the bit consists of an unembossed disk surface of $13,025 \pm 17$ microinches followed by an embossed disk surface of $26,049 \pm 34$ microinches, and having "one" bits configured such that the leading portion of the bit consists of an unembossed disk surface of $26,049 \pm 34$ microinches followed by an embossed disk surface of $13,025 \pm 17$ microinches.

12. A method for auto-configuring a disk drive to a diskette having a first surface and a second surface, comprising the steps of:

defining a media type code comprising information about a plurality of physical properties of a diskette coded in a plurality of "one" and "zero" bits;

defining a position on at least one of said surfaces of said diskette in which to place said media type code;

positioning a head in a disk drive to said position defined for said media type code whenever said diskette is first inserted into said disk drive;

reading said media type code from said diskette by said disk drive; and

configuring said disk drive in response to the media type code read, such that communication between said diskette and disk drive is optimized.

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13. The method of claim 12, wherein:

the reading is limited to an optical-magnetic type disk drive having optical positioning means and magnetic data recording means; and

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the defining of a position is limited to positions on a diskette comprising optical positioning tracks and magnetic data tracks.

14. The method of claim 13, further and firstly comprising the steps of:

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defining a "zero" bit to comprise a leading portion of an unembossed diskette surface of $13,025 \pm 17$ microinches to be followed by an embossed diskette surface of $26,049 \pm 34$ microinches; and

defining a "one" bit to comprise a leading portion of an unembossed diskette surface of $26,049 \pm 34$ microinches to be followed by an embossed diskette surface of $13,025 \pm 17$ microinches.

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15. The method of claim 12, wherein:

said first surface of said diskette is on the same side of said diskette that is engaged by a drive spindle; and

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the defining of a position on said diskette to place said media type code is limited to positioning on said first surface of said diskette.

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Fig_1(a)

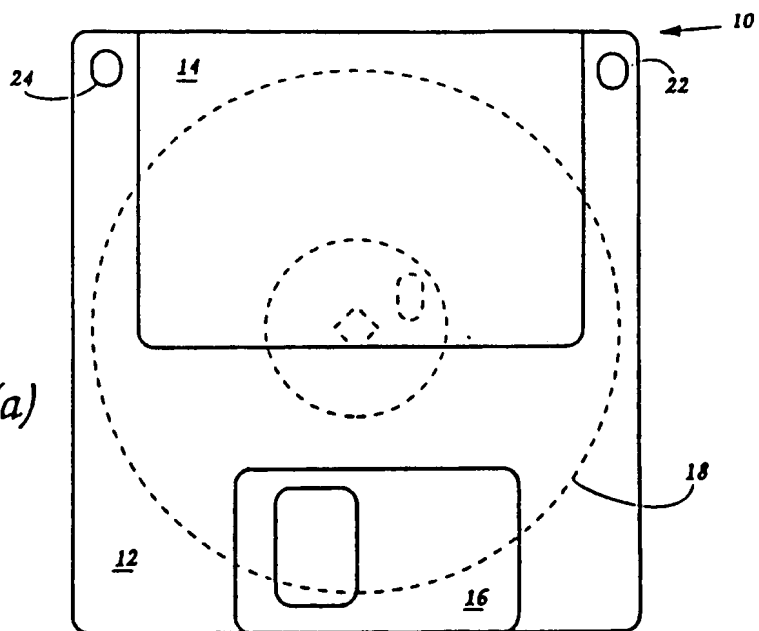
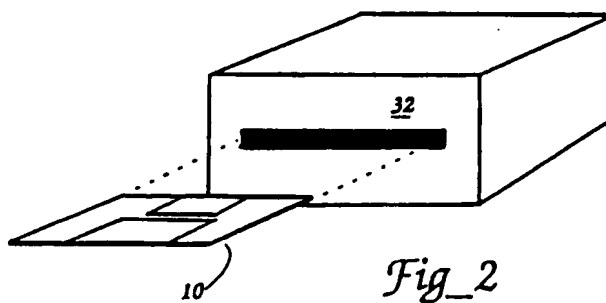
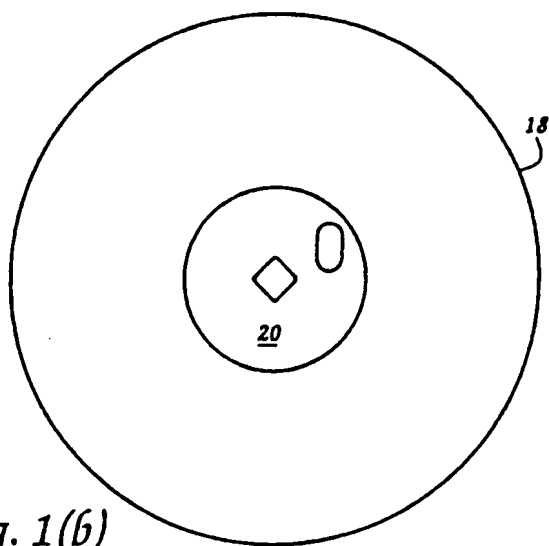


Fig. 1(b)



Fig_2

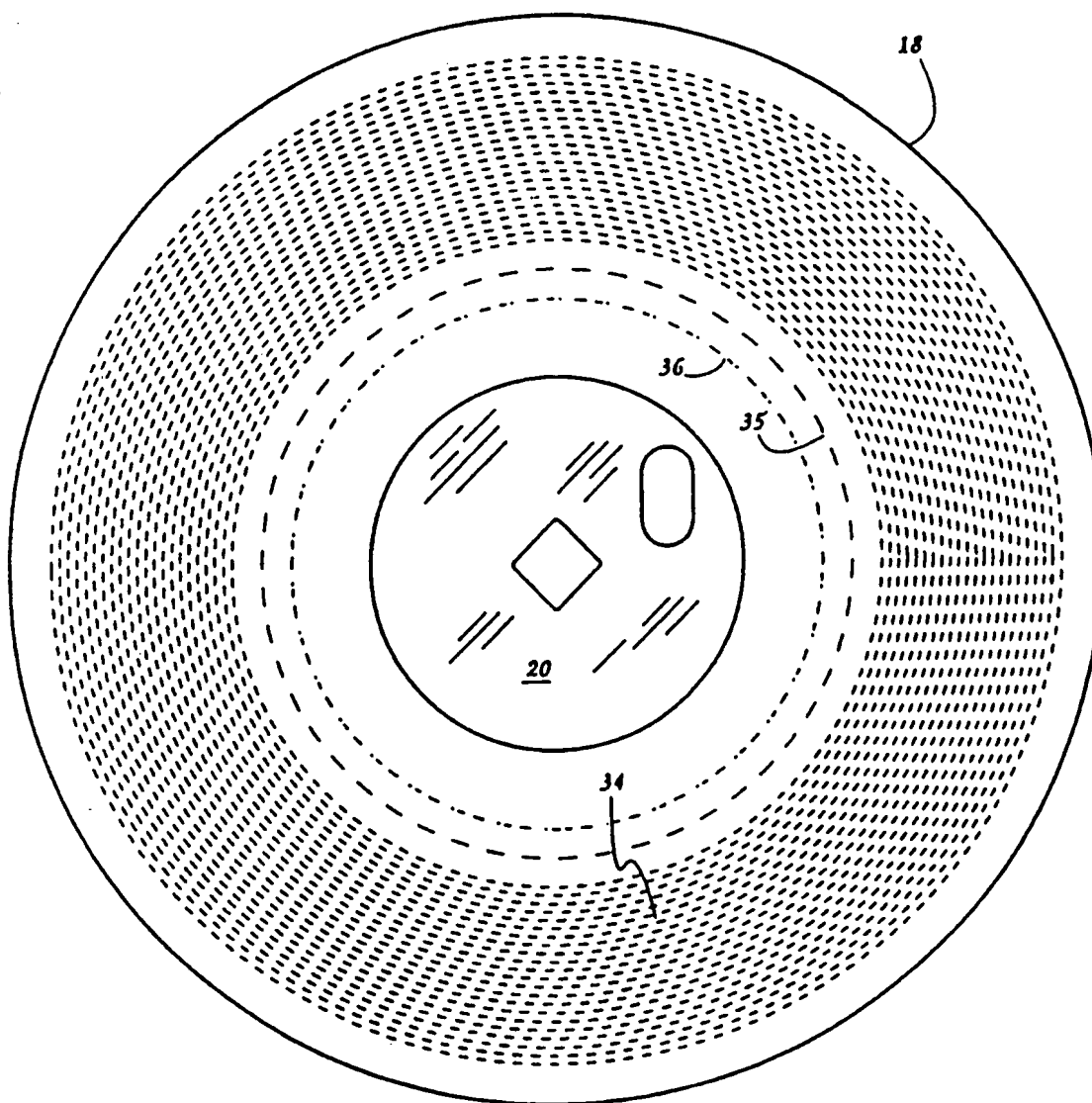


Fig. 3

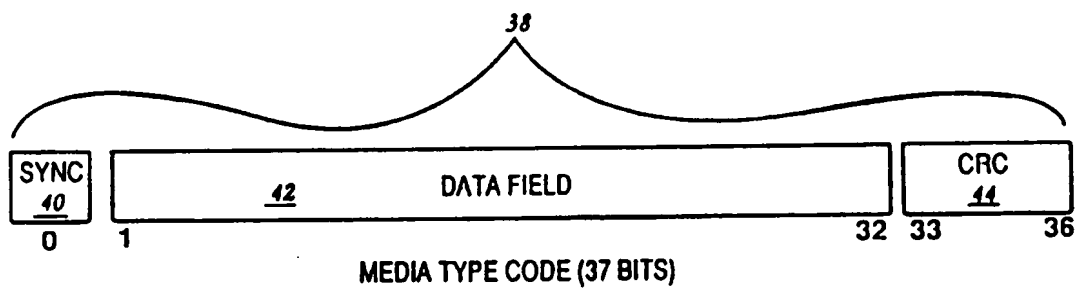


Fig. 4



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G11B 5/012, G11B 23/28,
G11B 23/30, G11B 23/03**

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66 Date of deferred publication of the search report:
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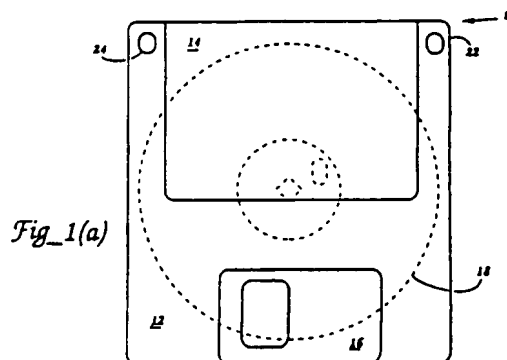
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54 **Media type identification system and method.**

57 A diskette comprising a jacket, a liner material disposed within said jacket, a flat circular media having a magnetic coating on both sides disposed within said liner material, a hub attached at the center of said media, a plurality of optical positioning tracks on at least one of said sides of said media, and a media type code optically embossed on at least one of said sides of said media. The media type code contains information about the physical properties of the particular diskette that will allow a disk drive unit to auto-configure itself to allow optimum data communication and performance.



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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.9)
Y	EP-A-0 097 774 (INTERNATIONAL BUSINESS MACHINES CORPORATION) 30 June 1982 * the whole document *	1-3	G11B19/12 G11B5/016 G11B5/596 G11B27/32
Y	DE-A-34 12 454 (MITSUBISHI DENKI K.K.) 4 October 1984 * the whole document *	1-3	G11B20/00 G11B5/82 G11B5/012 G11B23/28
A	DE-A-38 36 837 (SONY CORP) 11 May 1989 * the whole document *	1-5	G11B23/30 G11B23/03
A	COMPUTER SYSTEMS, vol.9, no.1, January 1989, BROMLEY GB pages 47 - 51 KREJCIK 'Floppy Optics' * the whole document *	1-5	
A	SPIE OPTICAL DATA STORAGE TOPICAL MEETING, vol.1078, 1989 pages 71 - 79, XP000041031 GODWIN 'An introduction to the Insite 325 Floptical Disk Drive' * the whole document *	1-5	TECHNICAL FIELDS SEARCHED (Int.Cl.9) G11B
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 231 (P-878) 29 May 1989 & JP-A-01 039 617 (VICTOR CO OF JAPAN LTD) 9 February 1989 * abstract *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 211 (P-303) (1648) 26 September 1984 & JP-A-59 094 242 (NIPPON DENKI K.K.) 30 May 1984 * abstract *	1	
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	19 October 1994	DEVERGRANNE, C	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : technological background O : non-written disclosure P : intermediate document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category		A : member of the same patent family, corresponding document	



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claims:
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,

namely:

See sheet -B-

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.

namely claims 1-5



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EUROPEAN SEARCH REPORT

Application Number
EP 91 11 8312

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claims	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 144 (P-284) (1581) 5 July 1984 & JP-A-59 042 653 (TOKYO SHIBAURA DENKI K.K.) 9 March 1984 * abstract *	1	
A	--- PATENT ABSTRACTS OF JAPAN vol. 13, no. 64 (P-827) 14 February 1989 & JP-A-63 251 924 (HITACHI LTD) 19 October 1989 * abstract *	1	
A	--- GB-A-2 084 379 (NIPPON VICTOR K.K.) 7 April 1982 -----		
The present search report has been drawn up for all claims.			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
Place of search THE HAGUE		Date of completion of the search 19 October 1994	Examiner DEVERGRANNE, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



European Patent
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EP 91 11 8312 -B-

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-5: Disk drive memory system
2. Claims 6-10: Media type code
3. Claim 11: 3,5 inch micro-floppy diskette
4. Claims 12-15: Method for auto-configuring a disk drive